

Sending A/V Signals Over Twisted Pair Cables: An Introduction

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Abstract

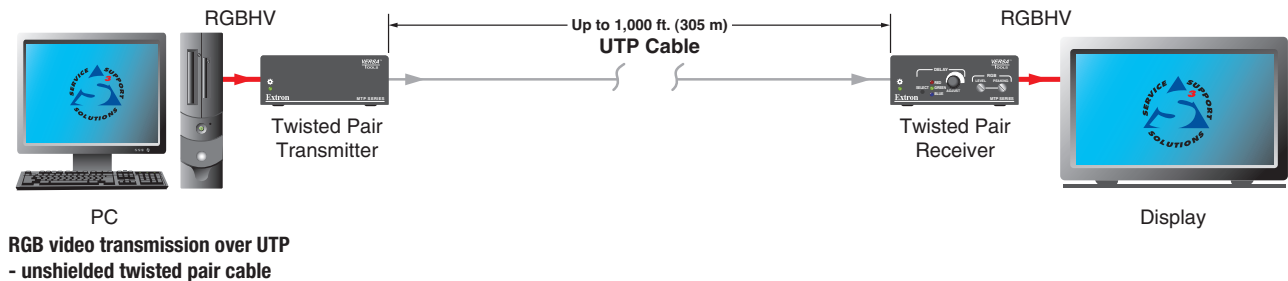
A/V over twisted pair is the transmission and distribution of audio and analog video, as well as control signals over wiring traditionally associated with data networking and telephone systems. This wiring is commonly known as UTP, or unshielded twisted pair. Special interfacing equipment is required to send video and audio signals over UTP wiring. UTP-based A/V systems are appealing for many applications because they offer numerous advantages in terms of cost and implementation, and deliver performance comparable to systems using RGB coaxial cabling.

white paper

What is A/V over twisted pair?

A/V over twisted pair is the transmission and distribution of audio and analog video, as well as control signals over wiring traditionally associated with data networking and telephone systems. This wiring, commonly known as UTP - unshielded twisted pair, comprises multiple pairs of conductors, each of which is twisted in accordance to design and performance considerations. Special interfacing equipment is necessary in order to send video and audio signals over twisted pair.

In a basic system, as shown below, a twisted pair transmitter formats the RGB computer-video output of a PC into signals specifically for transmission over UTP. A twisted pair receiver, located at the far end of the UTP run, then converts these signals back into conventional computer-video for display.



UTP cabling is classified by the TIA - Telecommunications Industries Association and EIA - Electronic Industries Alliance according to digital transmission criteria for data capacity, including CAT - Category 5, CAT 5e, and CAT 6. The installation of UTP cabling is essentially ubiquitous in office environments, conference and boardroom facilities, education institutions, and other venues with established data network and telephone infrastructures.

Although UTP cable was designed for data networking, it is also a viable, cost-effective alternative to running analog video and audio signals over conventional coaxial cabling. UTP-based A/V applications also have an important advantage of accommodating very long-distance signal transmission while, at the same time, maintaining performance comparable to systems using RGB coaxial cabling.

Before proceeding, it should be emphasized that twisted pair A/V systems require a dedicated cable infrastructure that is completely separate from that used for data networking or voice applications. Although twisted pair A/V and data network systems may seem interchangeable by virtue of a common type of cabling, they must be considered separate, distinct, and incompatible. Twisted pair A/V signals are not formatted as packetized digital data for transmission over Ethernet, and therefore cannot coexist with data network signals within the same UTP cabling.

What types of A/V signals can be sent over twisted pair?

Various types of analog video signals can be delivered over twisted pair wiring, including composite video, S-video, component video, and RGB. Twisted pair A/V technologies are also compatible with high definition video, and high resolution computer-video. Stereo and mono audio signals, analog or digital, are also transportable over UTP cabling. Furthermore, twisted pair A/V systems can accommodate control signals such as RS-232 for serial communication, thus enabling long distance control of A/V devices such as projectors and flat panel displays.

Using specially designed equipment, A/V signals can be distributed and routed over UTP cabling in the same manner as in conventional A/V systems. Therefore, full integration of an A/V system over a UTP cabling infrastructure is possible.

In addition to analog video signals, DVI and HDMI signals for digital video can be transmitted over UTP cable. HDMI can also carry digital audio and control signals. The Extron DVI 201 Tx/Rx is a transmitter and receiver set for sending DVI and HDMI signals over 200 feet (60 meters) of UTP cable.

What applications can effectively utilize twisted pair A/V solutions?

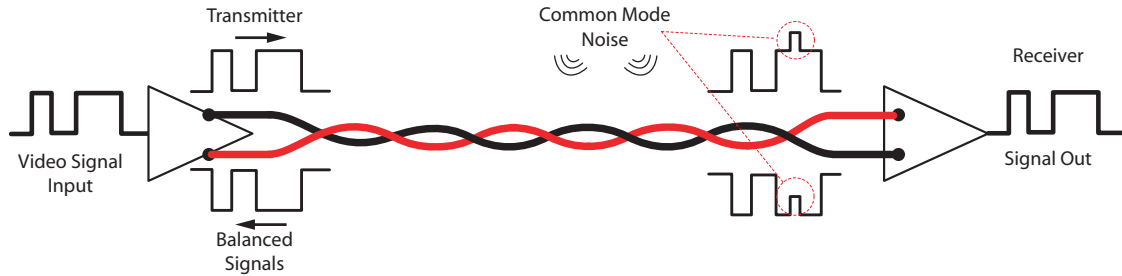
Twisted pair A/V systems are ideal for classrooms, courtrooms, boardrooms, government facilities, and houses of worship. For such environments, UTP may be preferred for cost, convenience, limited conduit space, and/or aesthetic reasons. In rental and staging applications, UTP cabling can be quickly and effectively deployed for addressing last-minute issues that may arise. Because of its low cost, the cable can be discarded after use.

Twisted pair A/V technology is also ideal for digital signage applications in entertainment venues, retail locations, and airports. These installations require A/V signals to be transmitted over long distances while at the same time ensuring pristine, high quality video and audio.

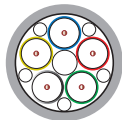
What are the benefits of A/V over twisted pair?

Using twisted pair A/V equipment, high resolution computer-video signals can be transmitted 500 feet (150 meters) or more over UTP cable. Twisted pair A/V systems offer high performance and long-distance transmission capability, due largely to the fact that the video signal is carried over UTP as a differential, or balanced, signal. The input video signal is converted into positive and negative, or differential, signals by the transmitter.

Along the cable run, these signals may be affected by external noise, such as transformers, electric motors, and fluorescent lighting. The noise induced into both differential signals is equal and of the same polarity, and referred to as common mode noise. When these signals are recombined at the receiver, the noise is canceled out, or subtracted, resulting in a clean video signal transmission with minimized noise degradation.



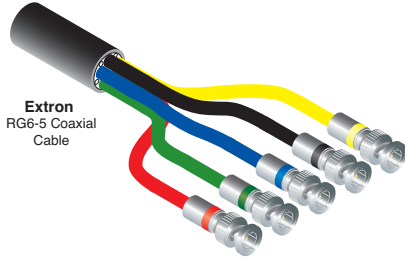
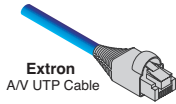
Balanced video signal transmission over twisted pair



UTP cable is easier to conceal or pull through conduit (actual sizes shown)

For certain applications, twisted pair A/V systems can be an attractive solution because of the potential cost savings. Facilities may have existing UTP cabling installations that can be devoted to A/V systems. When long distance cabling is a necessity, the cost of twisted pair equipment and inexpensive UTP cabling can be significantly less than an equivalent run of coaxial cable, especially in the hundreds of feet, for which an interface or peaking amplifier might be required.

A/V integrators and installers may also employ twisted pair A/V systems due to the lightweight, small cabling, as well as the simple and inexpensive terminations required. Situations could arise where, because of limited space, or in historically significant environments, coaxial cable cannot be installed within conduits or behind walls. UTP cable is much easier to conceal from view or feed through conduit than coaxial cable.



UTP cable is simple to terminate, requiring just one connector

What equipment is used in a twisted pair A/V system?

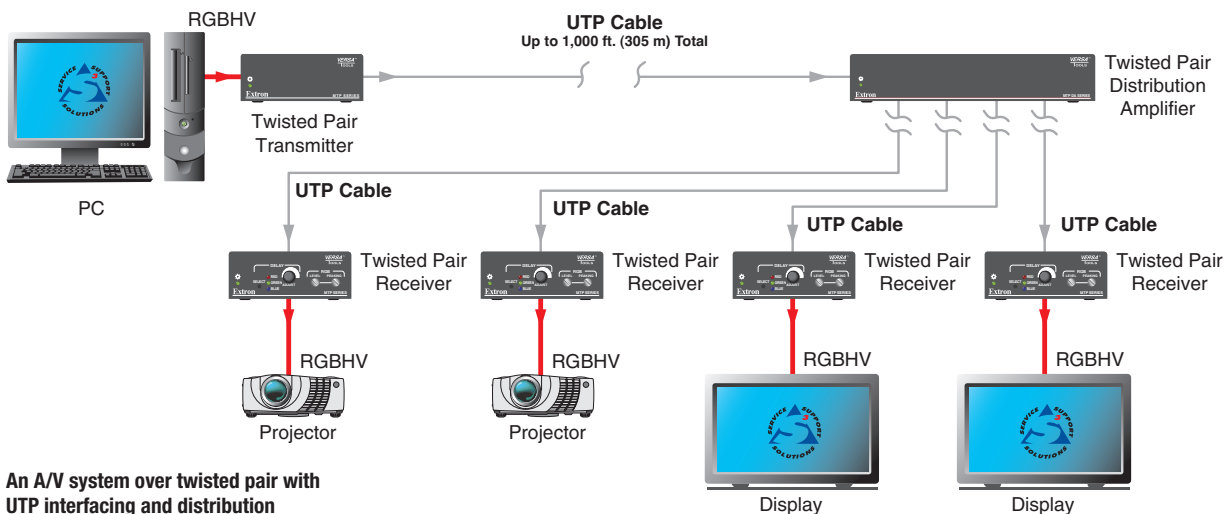
A twisted pair A/V system requires at least one transmitter to convert standard A/V signals to differential signals for twisted pair implementation, and at least one receiver to convert the signals back. Devices which provide conversion between balanced and unbalanced signals are classified as either passive — non-powered or active — powered.

Passive Devices

Passive devices are traditionally baluns, in which the signal conversion is accomplished using a transformer. Baluns have long been used for radio and television broadcasts. While such devices are suitable for composite video and S-video signal transmission at short distances — less than 100 feet (30 meters), Extron does not recommend them for computer-video signals or HDTV, since their performance is compromised at frequencies relevant to high resolution video.

Active Devices

Active transmitters and receivers provide far superior performance than passive baluns, and can accommodate video, HDTV, and high resolution computer-video, as well as audio and control. An additional, important distinction from passive baluns is the fact that they include equalization to compensate for signal loss resulting from long distance signal transmission. Active transmitters and receivers are typically standalone devices, but may also exist as part of A/V signal processors and routing equipment, including distribution amplifiers.



When multiple transmitters and receivers are to be employed, signal routing and distribution is likely necessary. Specialized twisted pair switchers, distribution amplifiers, and matrix switchers are available that function in essentially the same manner as their conventional A/V counterparts.

While CAT 5, CAT 5e, and CAT 6 UTP are likely to be the most common forms of cabling, other twisted pair wiring types can be employed, including STP - shielded twisted pair, and A/V UTP cabling from Extron, specifically designed for twisted pair A/V systems.

Important considerations for twisted pair A/V systems

Since twisted pair A/V and data network systems are incompatible, IT data routing equipment similarly are not suitable for A/V signals. Such equipment can be damaged by A/V signals because they measure at higher voltage levels than for data signals. Also, specially designed UTP cable for A/V applications do not conform to the TIA/EIA data transmission criteria, and therefore are not compatible with data communications.

Another important consideration, when designing and specifying twisted pair A/V systems, is that all transmitters, receivers, and distribution equipment must be provided by the same manufacturer. Each manufacturer has implemented a specific technology for A/V signal conversion and formatting that is incompatible with signaling approaches from other companies.

Extron Electronics, headquartered in Anaheim, CA, is a leading manufacturer of professional A/V system products including computer-video interfaces, switchers, matrix switchers, distribution amplifiers, video scalars, scan converters, signal processing devices, Ethernet control interfaces, and high resolution cables. Extron products are used to integrate video and audio into presentation systems for today's high tech boardrooms, presentation/training centers, university lecture halls, and other applications.

For additional information, please call an Extron Customer Support Representative at: 800.633.9876 (inside USA and Canada only) or 714.491.1500 for Extron USA; +800.3987.6673 (inside Europe only) or +31.33.453.4040 for Extron Europe; +800.7339.8766 or +65.6383.4400 for Extron Asia; +81.3.3511.7655 for Extron Japan.

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